a review of Quantum fields and noncommutative spacetime by Fredenhagen, Klaus

Langmann, Edwin

NC geometry and quantum fields: simple examples. (English) Zbl 1330.81186

Scheck, Florian (ed.) et al., Noncommutative geometry and the standard model of elementary particle physics. Proceedings of the conference, Hesselberg, Germany, March 14–19, 1999. Berlin: Springer (ISBN 3-540-44071-2/hbk). Lect. Notes Phys. 596, 278-298 (2002).

The aim of this paper is to discuss four examples where mathematical structures arising in noncommutative geometry (NCG) are useful in treating traditional issues in quantum field theory (QFT). The paper consists of seven sections. The first section is an introduction. The second section summarizes preliminaries from NCG and QFT. The third section deals with the first example. It is discussed how to obtain the Chern-Simons terms from effective fermion actions, where some NCG generalization of Yang-Mills theory naturally appears and it is exploited to make the computation effective and suggestive. The fourth section is self-contained, discussing elementary examples for regularization in the context of nonconverging series [*B. C. Berndt* and *R. A. Rankin*, Ramanujan: Letters and commentary. Providence, RI: American Mathematical Society (1995; Zbl 0842.01026)] as a warmup for the succeeding section. The fifth section gives a general discussion of how to regularize the Hilbert space trace and then illustrates this in case of pseudodifferential operators on $\mathbb{R}^n$. The sixth section shows how to compute the logarithmic divergent contribution to the effective action on $\mathbb{R}^4$ by taking advantage of the previous section. The final section explains how the result of the previous section is a physical interpretation of the well-known spectral action principle in NCG [*A. H. Chamseddine* and *A. Connes*, Commun. Math. Phys. 186, No. 3, 731–750 (1997; Zbl 0894.58007); *A. Connes*, Noncommutative geometry. Transl. from the French by Sterling Berberian. San Diego, CA: Academic Press (1994; Zbl 0818.46076)]. This paper can be regarded as a good invitation to the author's [Acta Phys. Pol. B 27, No. 10, 2477–2496 (1996; Zbl 0966.81549)].

For the entire collection see [Zbl 1027.00036].

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MSC:

81T75 Noncommutative geometry methods in quantum field theory
46L85 Noncommutative topology
58B34 Noncommutative geometry (à la Connes)
81R60 Noncommutative geometry in quantum theory
46L87 Noncommutative differential geometry

Full Text: DOI